problem. It's a problem that all of the circuitry that you put in there to separate the transmit and receive frequencies don't work and so you have to put in new diflexors.

So the cost penalty is much higher toward operating a two dot one than it is doing license and unlicensed in the one dot eight range.

MR. STANLEY: Irwin, did you want to say anything about that?

DR. JACOBS: Right. The only -- well, changing the frequency means two radios and you can't have as much comment on technology so it doesn't cost you more money.

The ability to use TDD in the unlicensed band, that is a less expensive approach for certain kinds of services and so that would reduce the cost difference, but you would still have a larger delta in going between the bands than you would within the same band.

MR. PEPPER: Just one other question on equipment. You were talking about equipment costs. That is where -- looking again, actually,

at John and Irwin, you've been actually involved in making equipment. What kinds of equipment do you see available, over what period of time, for the different bands? I mean, how close are you to, you know, rolling out consumer equipment, the base station equipment, transmitting equipment?

And also since PCS has been, you know, talked about over the last two years, especially the last day and a half, of the mass market consumer item, which is usually characterized by very low prices, or very competitive prices in the consumer end of the market and the handsets, I mean, how close are we to that kind of mass market product?

DR. JACOBS: The 1.8 gigahertz equipment is, I would say, closer because there's been a lot of focus on it internationally as well as out here in the U.S. And so some of the componentry is available, et cetera. And many of us have been building such a first-generation equipment for doing some of the initial testing of the 1.8 band. It just so happens we have a prototype of

such a telephone and that can be used at 1.8 here.

I think one of the key aspects of this PCS area that is important -- and by the way, I think of PCS as being something that may, in fact, be offered at this frequency but ultimately also with cellular. But one of the key issues is going to be much longer talk time. And so I think that you'll see this next generation coming out about the time of the availability of the spectrum as having, for example, five-hour talk time, so you can support these services and have more usage as compared to the existing types of equipment. Those will be available in --

MR. PEPPER: At price points competitive to cellular, below cellular equipment today?

DR. JACOBS: They will be competitive with the digital cellular equipments, maybe very -- somewhat slightly higher initially depending on volumes providing break outs and the amount the people want to control the price.

MR. PEPPER: John and Sandy, did you want

to --

MR. BATTIN: I wanted to comment on the timing issue. First of all, go back to standards. If the Commission says industry, you'd better have a standard, so we do have a standard so we know exactly what to design to. There's no doubt in my mind when you issue licenses we will have equipment ready to sell.

Pricewise I agree exactly with what Irwin says except that there is some microcell systems that offer the opportunity in major metropolitan areas where there's a lot of population density to drive the cost of this kind of service and do more consumer levels than what we have seen in cellular now.

MR. HALLER: Was that a challenge, by the way?

MR. BATTIN: What?

MR. HALLER: Was that a challenge; that you were going to have equipment out before we had licenses out? Well, I hope you're wrong. I hope we get the licenses out first. That's what I

hope.

MS. ABRAMSON: I would like to address both those questions on the timing and the price.

As far as the unlicensed band is concerned, you know UTAM is made up of a number of companies. And, in fact, this week we are going to be looking at a full-spectrum setting of where all the microwave links are. And if the band was allocated today and we had the final rules today, you would have equipment out in a very short amount of time. So I would just like to state that.

Also in terms of price, as you know, unlicensed equipment is largely a consumer market, which is very price sensitive. We've hired BIS to do market workouts for us. In fact, they've reported on it a little bit yesterday. But we've noticed that the market is extremely price sensitive. This is, again, another reason for us to remain in a band where there is fewer microwave links so that the fees that we put on the unlicensed equipment to pay for microwave

relocation is smaller so that we can keep the prices less.

If the prices have to be driven up to pay for more microwave relocation, we're going to price ourselves right out of the market.

MR. STANLEY: Thank you. Don, you wanted to ask a question?

MR. GIPS: John, this is for you and it relates to MSS.

You've asked that we return the 2180 to 2200 megahertz band allocated for the PCS to reserve for MSS.

It is our understanding that the band paired with that band per MSS is unusable in the U.S. because of the Broadcast Auxiliary Service. Would returning this to the reserve be useful to MSS at this point?

MR. BATTIN: Well, I guess you would have to buy into the premise that says the broadcast use is never, never, never moveable. I don't think the satellite issue is a 1995 problem. That's a reserved issue. It's 2,000 plus before

that's an issue. And, you know, I might suggest that maybe at that time frame we can figure out a way to move those services maybe within the same band, 5 or 10 megahertz one way or the other, but I don't have an answer right now. But I think in the long term those options have to be looked at.

MR. GAPS: May I ask one more follow-up to that? In terms of clearing the incumbents for MSS, is it your view -- sort of given the wide area of service you almost have to clear them nationwide to begin service. Have you done any estimates on what the costs of that might be, or any plans or thinking about how that might occur?

MR. BATTIN: I think the cost is going to be similar as it is for PCS. You know, it's 150 to 300,000 dollars per link. You know, count up the links and multiply it out and that's about it, and it doesn't make -- it does have the disadvantage -- you know, a lot of commits to unlicensed, that most of those -- well, all of those systems really have to be moved before you can go into operation on this spectrum. And, you

know, that's a problem.

MR. PEPPER: Sandy estimated earlier that it was about a billion dollars to move those -- to clear that band.

MS. ABRAMSON: Well, I estimated for 2.1 megahertz that it would be a move upward to two billion dollars.

MR. PEPPER: Two billion. But that would be for all 40 unlicensed -- if the unlicensed 40 megahertz were moved there, and John is talking about the 2180 to 2200, so half of the two is one. So it would be a minimum of a billion clear just based upon -- if you're correct about the --

MR. BATTIN: That sounds about right.

MS. ABRAMSON: I was thinking of the lower MSS spectrum.

MR. STANLEY: Let's switch the topic to unlicensed personal communication devices.

David, I guess your comment sparked several questions about the nature of the Data-PCS and coordinatable and nomadic/nonnomadic devices.

Taking away all these labels, most of the

descriptions of service that you've described are largely to a base station, which if you pick your words, you know, to choose to describe it, which you're in a sense largely coordinatable, and as such they fall well within the classification of other kinds -- similar devices. What is your general reaction to that?

DR. NAGEL: Well, Tom, I think there are some applications that one can think of. We've been working on this for probably five years now looking at the benefits that a service like Data-PCS would provide, particularly in education. I must admit we focused a great deal on that. And I think that one of the things that we have found is that the educational process, first of all, can be an enhancement to the use of technology, computers. That seems to be catechism at this point, I guess, in modern society.

But the surprising result was that when you allow children to collaborate, to communicate with one another, in talking about the educational learning process, that the process itself can

become more effective. And I think that's what has led us to focus on what we refer to as nomadic applications.

It is true that there are access to Internet and other services of that sort which would require some sort of a base station, some sort of ability to get in the wireline system, but that is, at best, a coequal requirement. I think that the initial studies which inspired our application for this entire proposition was the studies that showed that the nomadic applications were, in fact, the driving applications for this kind of service.

MR. STANLEY: To use the term, say, purely nomadic as opposed to those that are occasionally nomadic and, say, use a base station, your vision really sees two different classes of devices that are distinct enough to require different treatment?

DR. NAGEL: Of all the market studies that we have -- certainly, I mean, you can think of all sorts of applications once you have the

technology. But all the studies that we've shown suggests that the market growth would be much -- the most rapid by far if nomadic capabilities were provided.

MR. STANLEY: Again, by that you mean purely nomadic.

DR. NAGEL: Yes.

MR. STANLEY: Sandy.

MS. ABRAMSON: I think I would like to clarify. I believe what David is talking about is pure peer-to-peer communications. Many of the UTAM companies right now are in education and hospital-like markets, and in these markets there's a lot of -- you see in the forecast for connecting to an Internet -- connecting to an infrastructure, connecting to a different telepole like Bill's house does right now with (inaudible). And we do imagine there is some peer-to-peer communications but we do see a fast interest in connecting to, let's say, a library network. Or instead of dragging all your textbooks home, your engineering textbooks, or

your law textbooks, you can just dial up into your library to access that.

And for peer-to-peer repair we do see some use. We see some comical use. For example, hey, Tom, what answer did you get on question No. 3.

MR. STANLEY: Like the electronic cuff; writing the answers on your cuff link.

MS. ABRAMSON: Yes.

MR. STANLEY: Again, David, I guess part of the vice presidents and other people's visions as to the information highway literally brings the fiber to the school so there's great conductivity there in the notion of radio interfaces with that; that's a very, very natural thing. Isn't the purely nomadic in a sense, at one, removed from that concept?

DR. NAGEL: Well, I think it's never mute. I think it's compatible with a -- I think it enhances it. Again, this proposition of bringing Internet to every school, first of all, it's not realized yet. It's a great goal.

MR. STANLEY: It says it barely got it here

a few weeks ago.

DR. NAGEL: Yeah, I know. These things come and go. But I think that, again -- you know, I'll just repeat what I said. In all of the studies that we've done, both applied the research studies and the educational setting itself, it suggested what you referred to as purely nomadic, and nomadic applications are, in fact, the ones that seem to provide the greatest quantitative improvement in the educational process.

Certainly access electronic libraries, certainly access to other services which could be done with a base station providing that the schools could afford them.

Another advantage of the purely nomadic approach is that the overall system costs can be maintained at a much more lower cost per student. And, again, we think that for that reason the deployment -- the rate of deployment of these systems would be much more ramped if you could provide those kind of services. And unfortunately that leads to last link problems.

MR. STANLEY: Ralph, you wanted to ask a question?

MR. HALLER: Yes. I would like to turn, if I could, to the question of increased base station power.

I am trying to decide why that is an advantage because several people suggest that and if we leave the portable unit power where it is and we increase the base station power, it doesn't seem to me that we increase range unless that increased power comes from an antenna gain, in which case you get the appropriate gain on both receive and transmit. Am I correct in that; that we're really talking antenna gain increase of 10 DB as opposed to transmitter power increase? And I don't care who wants to take that.

MR. GRINDSTAFF: You're correct. And what a PCS operator will do in an environment is that you have your portable unit, your mobile unit out there and you always want to balance your link with the transmit/receive back to the base station. And by putting the restrictions on the

handset, it sets a limit of what your range is.

By doing things in the base station and increasing receiver sensitivity, increasing antenna gain, we can push out more power to that handset. And by having higher gain received and better received sensitivity at the base station where you can increase the cost of the base station and not the cost of the handset, you can increase the range of the mobile unit and the base station.

DR. JACOBS: One of the problems is the way that you specified it. You essentially said, as I recall, per PRP per channel. What is a channel? Well, in some cases it can be a 30 kilohertz-wide signal; another case with carrying just a small number of users; and other cases it could be a wider bandwidth signal. And in the case of CDMA it can be handling many such users. And so it needs some scaling factor in that to make it a reasonable kind of number. I don't think you want to work against the ability to use wider band signals more efficiently in putting that kind of

requirement in.

As you do go to the higher gain antennas, you look to get higher range. But I think your numbers, again, would -- under what would allow that, again, if you scaled it up, however, as you went to a wider bandwidth with more users.

MR. STANLEY: I thank you very much. I guess at this point there's just too many issues to recap and go into in any depth. What I would like to do is kind of ask each individual to identify what they would call the principal point they would like to leave us with; the one issue. And I guess there's several so let me limit you to one -- no complex sentences -- as to things you would like to keep us -- keep it for our -- before us in our deliberations.

Again, we'll start with Limond.

MR. GRINDSTAFF: Only one, huh.

MR. STANLEY: Only one.

MR. GRINDSTAFF: We feel strongly that 2100 megahertz is a viable spectrum allocation for detailed services and strongly recommend that they

not be -- be not moved or eliminated.

MR. FELKER: I think the crucial element, or at least one crucial element is assigning PCS operators ample spectrum, and I think 40 megahertz is sort of the optimal amount.

MR. STANLEY: Mr. Murray.

MR. MURRAY: I would like to urge you that if the set asides for the designated entities are in jeopardy or you're not considering them seriously, I urge the FCC to hold some meetings with minority groups to discuss the alternatives.

MR. STANLEY: Chuck.

MR. JACKSON: One quick historical observation. When I worked at the FCC, AT&T told us that 40 megahertz was the minimum that would work for cellular. When I worked on spectrum issues in New Zealand, Telecom New Zealand maintained that there was such strong economies of scale that they should get access to 40 megahertz, and I'm glad to see that as we work here today that same trade off between efficiency and the benefits of competition is still before you.

MR. PEPPER: Those were incumbents, weren't they?

MR. JACKSON: One was unlicensed. I mean, the cellular hadn't been licensed in this country at all when AT&T maintained first that 60 was needed and then later they backed down to 40. And in New Zealand some of the cellular spectrum was licensed otherwise and ultimately it wasn't licensed quite that way. It was auctioned off.

MR. STANLEY: John Battin.

MR. BATTIN: Hurry up, hurry up, hurry up. You're not far from having a very workable system. Let' be on with it.

DR. JACOBS: And I would just like to reiterate this idea of having some requirements for a standard.

DR. NAGEL: Clearly the most important issue for us is the band clearing issue for unlicensed systems, and I think the one thing I would urge is that as we develop a plan for clearing the spectrum that you keep in mind the importance of getting complete clearing for these

nomadic services because otherwise we have no wire.

MR. STANLEY: Thank you. Sandy.

MS. ABRAMSON: You guys did a bang up job in September for unlicensed. Don't change it.

MR. ROSENBLATT: The most significant issue relative to relocation is time, and that being the case, whatever the FCC can do to facilitate whether it's well-qualified rules or broader spectrum allocation would help the process.

MR. STANLEY: Thank you. Ralph?

MR. HALLER: Well, thank you. Let me, first of all, give you some information that may be of interest to you.

As we mentioned yesterday, the videotapes of this session are going to be available from our contractor. Information on that is available either outside the door or with Gail Brown sitting over here.

I also would like to mention without Gail Brown none of this would have happened. She's been putting in long hours on the weekends.

Also transcripts of this session -- of yesterday's session are available through International Transcription Service. The transcripts of yesterday's panels will be available this afternoon, and the transcripts of all panels will be available tomorrow afternoon. So if you want those, they are available through the International Transcription Service.

And now, of course, it's my distinct pleasure to announce to you the conclusions that the panel has reached. Having drawn consensus among all elements of the industry we now know exactly what we're going to do. Don't take your pad and pencil out because that's not quite the case.

At the risk of repaying myself a little bit for what I said last night, the issues here are exceedingly complex and we now will take the additional information we have learned here plus what's in the record and other pertinent comments that you may want to put in the record between now and April 22nd, we will look at those and we will

try to make some very informed decisions in very short order.

I continue to believe that the answers are ranges of right and wrong but not totally right and wrong. Everyone has different plans for how this band can be used, what services can be made available, who can use the band and the particular value to the American consumer.

There's no question there's a great deal of interest in this. We've had a packed room here and into the overflow rooms for both days. I think that says a great deal.

The fact that we put this panel together about a week ago and all of these panelists were anxious to come and present their presentations as quickly as this, indicates to me a great deal of interest. Certainly with that short time frame, it's taken a great deal of effort on the part of all the panelists in order to even be here today to get the arrangements from airlines and such to be here, let alone prepare the many, many documents that they have submitted.

Those documents by the way, are also available through ITS if you want them. Each panelist has submitted their own presentation.

We have a lot of people behind the scenes here at the Commission that have helped make this possible: Greg Rosten; Rene Lickt (phonetic spelling); Dan Oliver back running the cameras with his crew; Gail Brown; Susan Salad. And I'm sure I've missed a number of people in this, and I apologize to them for that. But the FCC staff gave us a tremendous amount of support in putting this together, also, so I would be negligent in not mentioning them.

We are now going to take this information and we are going to try to reach a very speedy solution on it. The one thing that we have heard is don't delay and we're not going to. We will be working to get our recommendations to the Commission absolutely as quickly as possible. All of us are dedicated to do this and if we need additional resources in the Commission to help make it faster, we'll get those resources and put

it on this project.

This is one of the most important decisions that the Commission is probably going to make in this decade. The decisions here are going to affect people's lives, the way they actually communicate with each other. It's going to change a paradine of device-to-device communication to a paradine of person-to-person communication, not just with voice but with data and enhanced video services. That is very significant. Perhaps as significant as the original invention of the telephone.

We have a very, very important job to do now in the next few days and we're going to do that...in the next few days.

I think that we will, in fact, be able to come out with a very reasonable recommendation to the Commission. When we do that, we certainly will have had the benefit of a great deal of debate, a great deal of input from very knowledgeable people and we'll do our best to put all that together and try to make the pieces fit

together in a puzzle that ultimately proves to be helpful in the creation of jobs in this country, expansion of the economy, provisions of universal service. All of those are very, very important goals that we have to deal with at this point.

And so with that I thank all of you for your participation here, for coming to these meetings. I would encourage any of you with new thoughts to put those on the record so that we can have the benefit of those.

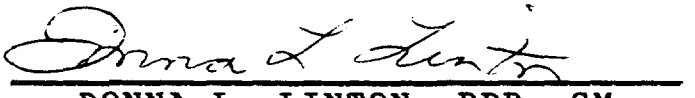
And with that, thank you very much again, and I now close this meeting.

(Thereupon, at approximately 12:00 o'clock, p.m., the above proceedings were concluded.)

* * * * *

CERTIFICATE OF COURT REPORTER

I, DONNA L. LINTON, Registered Professional Reporter and Certificate of Merit holder hereby certify that the hearing was recorded by me in shorthand and electronically at the time and place mentioned in the caption hereof and thereafter transcribed by me; that said hearing is a true record of the testimony given by said participants; that I am neither counsel for, related to, nor employed by any of the parties to the action in which this hearing was taken; and further, that I am not a relative or employee of any counsel or attorney employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.



DONNA L. LINTON, RPR, CM